DAMP-PROOFING HOLLOW TILE HOUSES

The walls of this house were treated with a transparent waterproofing compound to remedy dampness inside which later was found to come from cracks between the wooden frames and tile walls, and was not remedied until the cracks were packed with oakum.

DAMP-PROOFING HOLLOW TILE HOUSES

By

PERRY R. MACNEILLE
Architect and Consulting Engineer

The Author

The author of this article, Perry R. MacNeille, began his professional career as a surveyor on the New Haven Railroad. From this he gradually worked into the practical side of architectural engineering and is at present a member of the firm of Mann & MacNeille, Architects. He has been instrumental in developing the possibilities of hollow tile as a building material and is an expert in this form of construction.

Summary

Hollow Tile Houses Properly Constructed are the Dryest Form of Masonry Construction.

Where There is Trouble From Dampness it May Result From Any of the Following Causes:

I. Woodwork of Sills or Frames Has Shrunk Away From the Masonry.
Remedy. Pack the cracks with oakum or caulking cotton.

II. Stone or Concrete Sills or Belt Courses Run Entirely Through the Wall and Transmit Moisture.
Remedy. Paint the concealed faces of sills and belt courses with a bituminous or other waterproofing compound. If already built in, coat on the outside with a transparent waterproofing coating.

III. Holes in Hollow Tile Have Been Filled in With Mortar.
Remedy. Do not fill the holes, or where necessary to do this for beam support fill only the inside row of holes. If the holes straight through the wall have to be filled then coat this portion of the wall and a surrounding area three feet wide with a bituminous coating.

IV. Parapet Walls Have Been Carried Above the Roof.
Remedy. Look to the flashing and see that it is tight and carried above the line of melting snow.

V. The Building Has Settled and Opened Cracks Through the Walls.
Remedy. Build firmer foundations and avoid supporting tile on wooden lintels, girders or posts. If the building is completed, cut out the cracks and fill them with mortar mixed one part Portland Cement, two and one-half parts sharp sand and one-twentieth part hydrated lime.

VI. Hollow Tile Have Been Carelessly Set and Bedded on Their Side.
Remedy. It is too late to have a good mason do the work, and so defective places, where they can be found, must be pointed up and made good and the plaster removed for a wide area around damp places and the tile coated with a bituminous coating and replastered while it is "tacky."

This Last Defect is Infrequently Found and Generally Results From the Employment of a Poor Contractor Who is Also Ignorant of Hollow Tile Construction.
In General. Mix the stucco for covering the hollow tile one part Portland Cement, two and one-half parts sharp sand and hydrated lime enough to equal 10% of the cement, mixing these ingredients dry until they are of uniform color, then adding water and properly tempering. Finish the stucco with a spatter coat, fine or coarse, according to taste.

General Description of Damp-Proofing Methods and Materials

ANY Architect who, seated in his office, has listened to different waterproofing experts defend the merits of their system, must have felt his head whirling with an undigested mass of technical terms, such as bituminous lubrication of the mortar, substances miscible with water and insoluble after the mortar has set, de-emulsification, stearates, oleates, resinates, soapy material, lime salts, fatty acids, alum, colloydal substances or varnish gum. One man will quote the American Society for Testing Materials, another, the professors at some university, still another, different officials in the United States government, so that through the adroitness of the different salesmen, almost any material or method will appear, at the time, to be the best one.

Under these conditions the Architect can hope to make a selection of the best method of waterproofing only by applying certain underlying principles with which he can test the merits of each system.

MORTAR AND CONCRETE

Mortar and concrete fail in waterproofing qualities either through the mixture being so porous that the water will pass through it, and this is the case even in a 1 to 3 mixture, or through the development of cracks which may be easily visible or almost invisible. The porous nature of mortar and concrete is governed by the density of the mass and this varies according to the aggregate and the amount of water used in mixing. Cracks in mortar or concrete develop from two causes; one from settlement of the walls and the other through expansion and contraction, which occurs in mortar and concrete through the action of heat, and also through the action of moisture, the mass expanding as it becomes wet and contracting as it dries, and this occurs not only during the time of erecting the building, but continues for years afterwards. In waterproofing work, therefore, it is necessary to have a dense mass without cracks and if this is not possible, it is then necessary to cover the work with a damp-proof coating.

Dense masses of mortar or concrete are best insured by carefully grading the aggregate so that there will be enough cement to fill the voids in the fine sand, enough of the mixture of these two to fill the voids in the coarse sand, and of these three to fill the voids in the stone. There must not be too much of any one ingredient because too much cement increases the range of expansion and contraction under varying

conditions of moisture and too much sand or stone weakens the mass or leaves it with voids. Ample water is necessary in mixing to insure complete union among all the parts and a compact settlement where put in place. The best cements are finely ground and as a result have the maximum exposure to the action of the water which they readily absorb in the chemical action that takes place in setting.

In this way, therefore, by proportioning the aggregate and making a wet mixture without the use of any waterproofing compounds the most waterproof mass of mortar or concrete is obtained, but to properly proportion the aggregate, especially in the construction of private dwellings where the quantity of mortar and concrete used is relatively small and the expense of procuring the best aggregate is large, is frequently impracticable so that it is desirable under such conditions to use some void filling material.

The waterproofing of mortar or concrete with a void filling material is called the *Integral Method.* In using this method the choice of the void filler to be used will depend on cost and availability and to aid in determining these a brief description of the void fillers in general use is given below.

HYDRATED DOLOMITIC LIME, FINELY GROUND CLAY, OR FELDSPAR, mixed 1 part of filler to 20 parts of cement more or less, will fill the voids without producing any injurious effect between themselves and the cement and are not liable to serious deterioration as the work ages.

ACTIVE FILLERS or those substances which are supposed to react in the presence of the cement and then produce unchanging void fillers, depend upon a reaction for their success, and unless this takes place, are useless, but even if the reaction occurs successfully, it is difficult to see why they make any better void fillers than those substances mentioned in the preceding paragraph.

Persons discussing these fillers refer to resinate of potash in the presence of free lime reacting to form the more insoluble resinate of lime or to saponifiable oil which forms an insoluble lime soap, but no array of scientific verbiage can alter the mechanical and chemical results from the use of these substances.

WATER REPELLING FILLERS are supposed to repel the water in addition to filling the voids. Principal among these is ordinary soap, which, when dissolved in water and mixed with cement precipitates the more insoluble lime soap and makes a water repelling compound. In the forms sold, they consist of a fat acid combined with ordinary soap or lime, or, in scientific language, these substances are stearic acids combined with either soda and potash or lime. The greater part of the material is hydrated lime and magnesia lime which act as void fillers. It is not apparent why these compounds will repel water from the concrete and not equally repel it from the cement and prevent a proper set, and it would appear that any effectiveness they may have results from filling the voids rather than from repelling the water.

Hollow tile house situated on a high ridge exposed to severe storms. Cracks between wooden frames and masonry packed with oakum and hydrated lime mixed with the stucco. No trouble from dampness.

WATERPROOF COATINGS

All of the substances just described have for their purpose the filling of the voids in mortar and concrete and making a dense mass impervious to water. It will readily be seen, however, that if after this mass is in place cracks develop, its density will not prevent water coming through. For this defect the remedy is to cut out the cracks and refill them, or to waterproof the mortar or concrete by the application of some waterproofing compound. Waterproofing in this way is known as the *Coating Method*. The compounds now on the market are over forty in number and are composed of either linseed oil, paint and varnishes, asphaltums, wood tar, bitumens, liquid hydro-carbons, soaps or various other substances. A short description of the character of these different substances will aid in determining which it is wisest to use.

Linseed Oil, Paint, Varnishes, Etc. contain a large amount of hard resins and a small amount of linseed oil and are, therefore, inelastic. The life of the linseed oil is short and substances of this nature are of very questionable use in permanent waterproofing work.

Black Damp-Proof Coatings are generally made of rock asphalt cut down with crude still bottoms of petroleum residue and benzine.

The benzine quickly evaporates so that the petroleum residue is all that remains to prevent the asphalt returning to its original brittle state. This residue eventually evaporates also, and then the coating ceases to be effective.

BITUMEN COATINGS are made by cooking the crude bitumens to drive off the light hydro-carbon oils and then to the heavy mass that results, adding these oils again in greater or less proportion, according to the class of work for which the coating is intended. These products vary from the very heavy waxy material such as is used for coating the outside of cellar walls to the thin transparent coatings used in waterproofing stucco and brick work externally where it is not permissible to change the color or the texture of the surface. These products are, perhaps, the best for waterproof coatings.

ORDINARY SOAPS or the stearates of soda and potash are known from common experience to be readily soluble in water and are in all probability a poor waterproofing material. The claim that they react to form insoluble compounds has not, so far as I know, been satisfactorily demonstrated.

In hollow tile houses the coating compounds can be applied to the tile either on the outside before the stucco or brick veneer is applied or they can be put on the inside of the tile before the plastering is applied. The former method is probably the more satisfactory as it arrests the moisture at the outside of the wall and the coating is less liable to injury through building operations. A coating on the inside of the wall is almost certain to be broken into for pipe chases and other purposes. Before the coating is applied it is important to see that the joints are pointed up and that there are no projecting pieces of mortar which could break off after the coating has been put on, and thus leave an unprotected portion of the wall.

The bitumen coatings are the best adapted for this purpose. The plastering or stucco should be applied while they are still tacky, and care should be taken to see that dust has not blown against them as this would tend to weaken the bond of the mortar.

The lighter transparent coatings are not suited for this work and are adapted only to waterproofing walls entirely completed, such as the outside of stucco or brick work. In using these coatings care must be taken to prevent their being applied until all masonry work has been done in their vicinity, as mortar will not stick to surfaces that have been treated with them after they have dried. Coating compounds that are applied to the outside of cellar walls should be the heavier asphalt bitumens. These are on the market in a form that can be applied cold and will need no outside protective masonry under ordinary conditions.

The plaster in this room was applied directly to the hollow tile and no precautions taken against dampness, except mixing hydrated lime with the stucco and packing the cracks around the frames with oakum. There has been no trouble from dampness, not even sweating of the walls, although the atmosphere is frequently very humid.

HISTORY OF THE HOLLOW TILE HOUSE

THE history of hollow tile is of recent date. Mr. E. R. Rosse, a Frenchman, brought to this country a process for making hollow tile with a composition of lime, but shortly after the product was put upon the market a better material from which to make this tile was found in the low grade clays that were being stripped from the beds and thrown to waste to uncover the fine clay used in the manufacture of pottery. Among the pioneers in this new manufacture was Mr. George H. Johnson of Chicago.

Hollow tile made of this coarse clay came rapidly into popularity for use in fireproof floors, and later on, though more slowly, into use for the walls of buildings. For this latter use it was at first thought that the soft burned tile was better than the hard burned ones, since, on account of the better suction, they gave a firmer hold to the stucco covering. The soft tile was better than the hard ones to hold stucco, yet this soft tile was more porous than the hard burned ones and so had

to have some protection against moisture in addition to the stucco covering. In this way was presented the first problem in waterproof terra cotta, or so-called "Hollow Tile."

As the popularity of hollow tile for wall construction increased, improvements in their design and manufacture were made. Among these was the scoring of the surface with dovetail ribs to furnish a firm hold for the stucco and thus make it possible to use the hard burned tile which were stronger than the soft burned ones and more impervious to water. Since the use of this hard tile the trouble with damp walls caused directly by the tile has practically disappeared, and the hollow tile wall has become the dryest of any known wall of masonry construction. This fact is indicated by its being almost the only masonry construction where furring or its equivalent is not necessary on the inside of the wall to insure dryness.

It is, therefore, in the conditions surrounding the tile such as the mortar in which they are set, or the stone sills or concrete belt courses in the walls, that the principal causes of dampness are to be found rather than in the tile themselves.

Hollow tile veneered with brick. Hydrated lime was mixed with the mortar and no other precaution against damp walls has been found necessary.

Damp-Proofing in Hollow Tile Construction

IN every Architect's experience the time comes when one of his clients will send an imperative message saying that his house is leaking badly, that serious injury has been done to the ceilings, and that men must instantly be sent to make good the damage. In many of these cases the trouble is from rain that has blown in through an open window and soaked through the floor down to the ceiling below. With the others the greater part are still from a window although this time a closed one. The wood in the window frames and sills, has dried and shrunk away from the masonry and opened cracks that even when small will admit a quantity of water during a driving rainstorm. This water will show in large damp areas around the windows and especially between the sills and the floor.

In hollow tile houses the inside plaster is applied directly to the hollow tile without any intervening space made by the furring which is necessary with brick, stone or concrete walls, and, therefore, many causes for dampness that the furring would hide in the latter forms of construction is attributed to the hollow tile in the former, and they are given the blame for dampness that comes from other causes.

One of these causes is in the use of concrete or stone for the window sills and for the ornamental projecting bands around a house. Stone is more or less porous, and concrete when mixed comparatively dry, is very porous, so that these sills or bands projecting through the walls transmit the water directly to the plaster and the capillary attraction in the plaster will often dampen surrounding areas of several square feet. In the case of the band courses these areas might be remote from the windows and give every appearance of dampness that had come directly through the hollow tile. Moisture has been known to creep up a wall from this cause to a height of two or more feet above the belt course.

Another cause is from roof water flowing into the hollow spaces in the hollow tile through defective roofs or through imperfect flashing. These wet spots may appear in any part of the walls, since the water will flow through the hollow spaces in the tile and only appear where its course is intercepted.

If any applied ornament or wood work extends through the stucco to the hollow tile and the joint between it and the stucco is not perfectly tight, water will enter in this way; or, if wooden beams come through the walls from the outside they will absorb and transmit moisture.

Last—although a less frequent cause than generally supposed—dampness is transmitted through the cement joints between the tile. Cement mortar, like concrete, is more or less porous when mixed dry and will transmit dampness and there have been cases where dampness to the plaster inside has been caused in this way.

These causes of damp walls are the ones generally met with and when it has been determined which of them is the existing one in any instance the remedy is not hard to find. If the leakage is around window frames or under the wooden window sills, shreds of oakum, such as any plumber uses, can be forced into the cracks with a putty knife. It is better to use this oakum, as it comes, rather than soaking it in oil, as the oil is liable to stain the stucco. If windows and sills are treated in this manner while in course of erection, the possibility of future trouble would be obviated.

If the trouble is with band courses or window sills, these can be painted on the faces to be buried in the wall with Anti-hydrene or Minwax Waterproofing, or, if already in the wall, they can be painted on the outside with Edison's Waterproofing Paint or Minwax Clear Waterproofing Compound.

If trouble arises where flat roofs meet walls carried above them, these joints should be made tight with tin or copper flashing strips, made fast to metal roofs by soldering, or to gravel or slag roofs by running between two layers of the felt. This flashing should be carried up the wall to a height above which snow can not collect, and then turned into a joint in the masonry.

Any danger from dampness coming through the mortar joints between the hollow tile can be avoided by mixing with the cement used

Miners' houses in the Pennsylvania mountains, built with tile exposed on the exterior and some of them having the tile exposed on the interior as well. The mortar joints were carefully made, hydrated lime was used in the mixture and air spaces were formed in the vertical joints. The walls have proved impervious to moisture under a test of a heavy stream of water from a hose applied for two hours.

in the mortar 5% to 10% of hydrated dolomitic lime or finely ground clay or by adding to the cement 2% of waterproofing powder such as is sold by the Integral Waterproofing Company.

Until within a few years, hollow tile houses have been built of tile 12″ square and of any desired thickness and covered on the outside with cement plaster or stucco, or veneered with brick. These coverings entirely conceal the hollow tile, and in a way, produced a sham architecture. Baked clay, as a material, is beautiful in itself, and when the hollow tile are made of the right texture, color and dimensions, very beautiful walls result.

A hollow tile known as "Textile" has recently been put upon the market which is unsurpassed in beauty of texture and shading. There is also tile that has the surface roughened to remove the semi-glaze that is natural to the tile and to give a surface somewhat similar to brick. Such tile as this is intended to be exposed in the finished work and it is probable that in exposed places some form of waterproofing them may be desirable. I say "probably" because there are many instances where uncoated and exposed hollow tile have withstood the weather and have not transmitted dampness.

Exposed tile on the exterior of this house has satisfactorily withstood the weather. It was applied as a veneer to frame construction.

This tile can be waterproofed by coating it on the inside before plastering with Anti-hydrene or with some bituminous compound, or, it can be waterproofed on the outside by coating it with Minwax Colorless Damp-proofing or Edison's Waterproofing Paint. The inside method of application removes any possibility of dulling the freshness of the texture of the outside of the walls but is more difficult to make the coating continuous on account of pipe chases, beams and other parts of the structure.

By observing the recommendations given above the different damp-proofing difficulties in hollow tile construction will be overcome. There will still exist, however, those troubles met with in all houses in making dry cellars. These difficulties will have to be considered by themselves.

Waterproofing the Cellar

I have but twice seen a "flooded cellar," although my clients have often told me their cellar was flooded when there were a few puddles on the floor. The first flooded cellar was in a Philadelphia tenement, and the water stood about three feet deep after every rain storm, with the result that no attempt was made to use this cellar. The second flooded cellar was in my own house the morning after our main water supply pipe burst, and the memory of wading in this cold water to shut off the valve is only less vivid in my mind than my wife's reply to the foreman of the repair gang from the Water Company. He asked how long the leak had been running, and she said we could not tell until we saw our water bill.

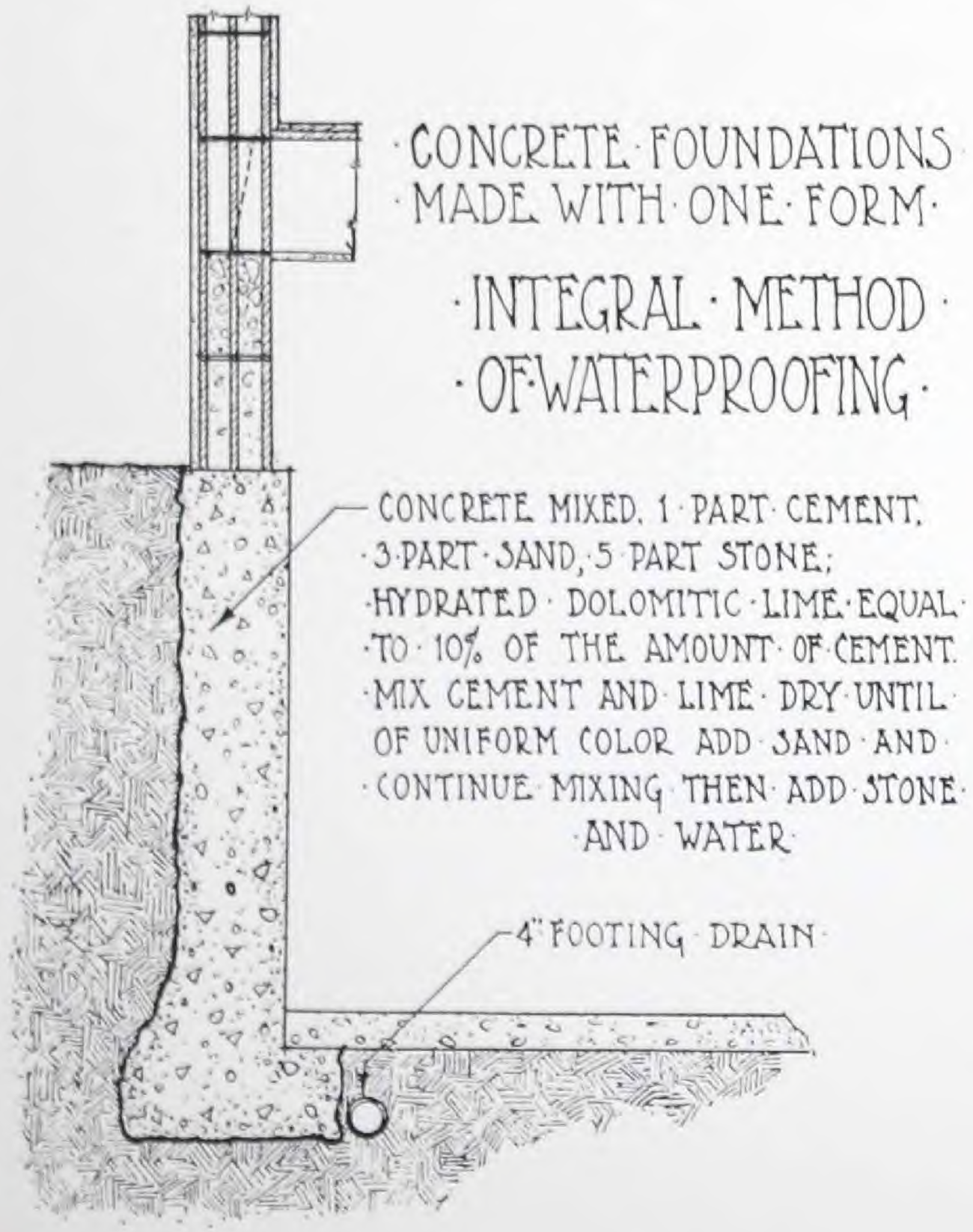
But whether a cellar is flooded or simply damp, those living in the house have causes of complaint founded both on considerations of health, and on probable damage to the furnishings of the house, and it is, therefore, an important duty of the architect to trace the causes of wet cellars and to find the remedies.

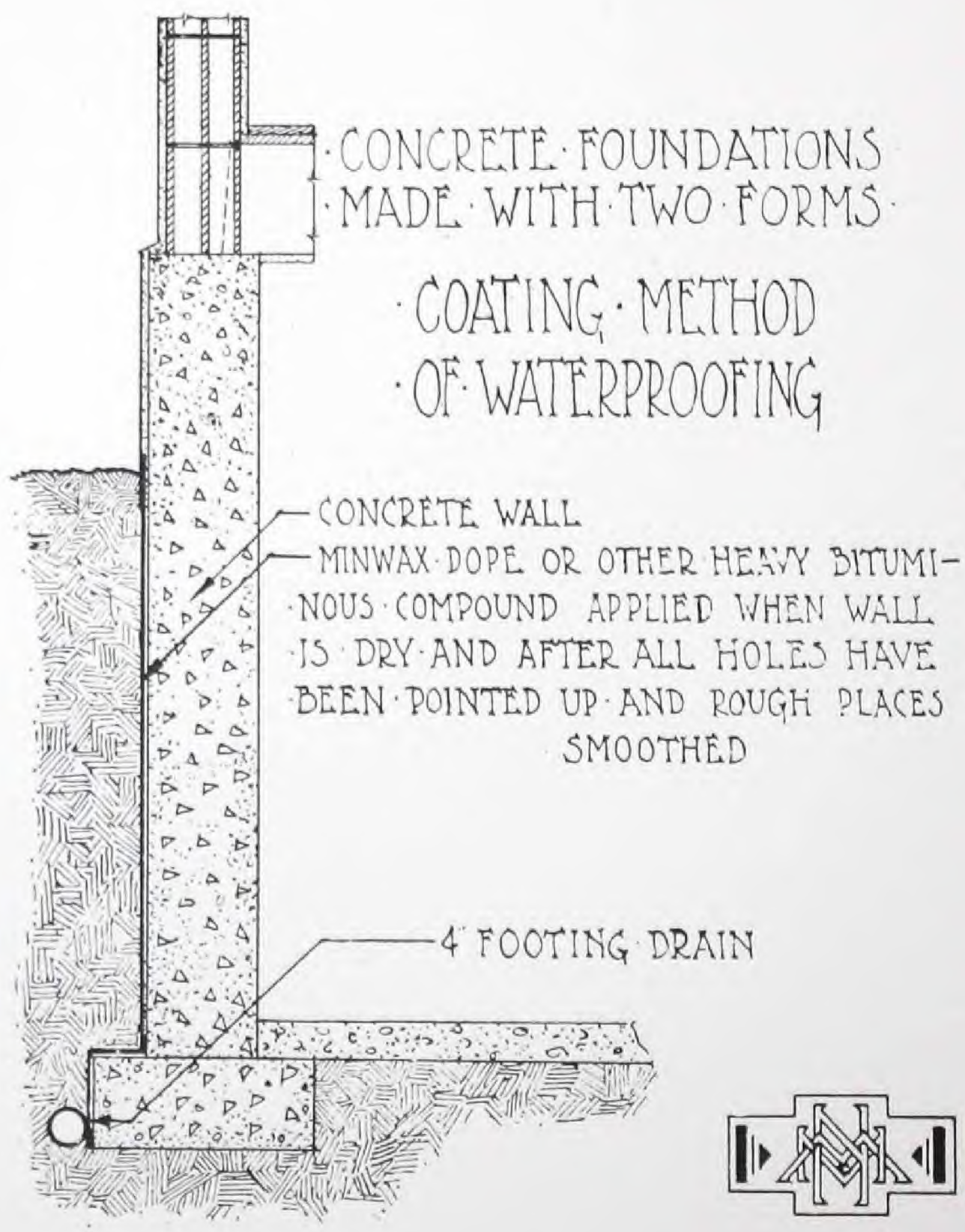
CAUSES OF WET CELLARS

The causes of damp or wet cellars can be grouped under the following heads: (1) springs or underground streams; (2) surface water; (3) water from the roofs.

Permanent springs are rarely a source of trouble since it is known in advance that they exist and provision is made for them, but intermittent springs frequently cause trouble since they may not be discovered until after the building is completed. The reason for this is that they are caused by an intermittent flow from some natural underground reservoir.

A bowl in the rock or pocket in the sub-strata will slowly fill until it overflows, and then the flow will continue by syphonic action until the bowl is empty. Such action can be illustrated by filling a rubber tube with water, thrusting one end in a tub of water and holding the other end below the bottom of the tub. The water will flow out through





Detail Drawing of Concrete Cellar Walls

the tube until the tub is empty. In the ground a seam in the rock or an underground water course replaces the rubber tube in the illustration I have given.

Water from an intermittent spring if intercepted by the cellar of a house may make its appearance through the side of the cellar wall, in the middle of the cellar floor or at any other point of weakness.

Water which flows in a broad sheet and oozes from the sides of the excavation is not generally from a spring but is surface water that has penetrated the soil until it has reached a denser strata over which it flows toward lower water courses. It will generally make its presence known in a cellar by causing dampness along the entire foundation wall that is nearest to its source.

Surface water will also flow directly into the cellar through the cellar windows during a rain storm, or, when it finds its way to low ground will so saturate the soil that water will seep into the cellar from all sides. It frequently happens that on high ground and ridges that would generally be thought dry, the rock or dense strata near the surface forms pockets which collect the surface water and create conditions almost as difficult to deal with as those in low ground.

Where the flow of water is continuous and large, the foundation work has probably intercepted the course of a former stream which has been filled in at some period of the city's development. These filled-in streams seem to continue their flow underground and they cause great difficulty in the waterproofing of cellars.

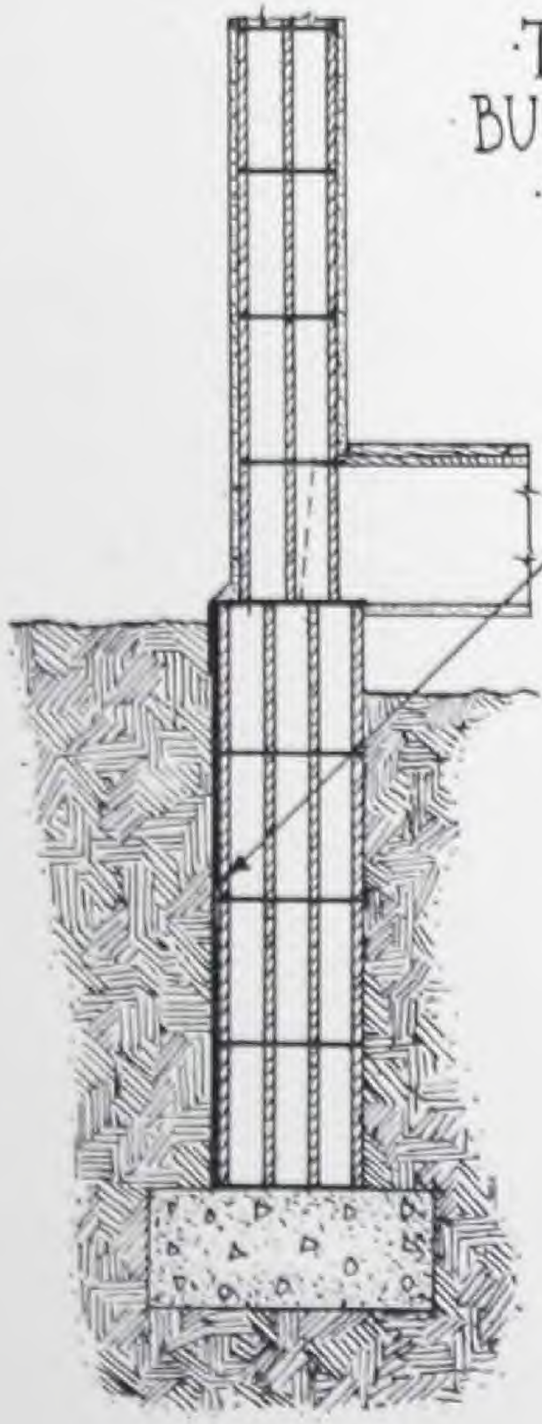
While the natural causes of wetness and dampness that have been mentioned above are frequently met with, it is more often found that water in the cellar comes from causes immediately connected with the erection of the building. If the gutters on the roof have become stopped and the water overflows from them, it may find its way directly into the cellar, or, if the leader drains, that is, the underground drains carrying the water from the leaders, have been laid on soft ground, a slight settlement in them may open a joint through which the water they collect is emptied directly against the foundation walls. If the outlets to these underground drains are not adequate, or, if they are stopped up, or, if they are broken during building operations and remain unrepaired, they may cause dampness in the cellar.

It will be seen, therefore, that the causes for damp cellars are numerous, and it can well be inferred that the remedies are equally numerous, but the cause must first be traced if the cheapest remedy is to be used.

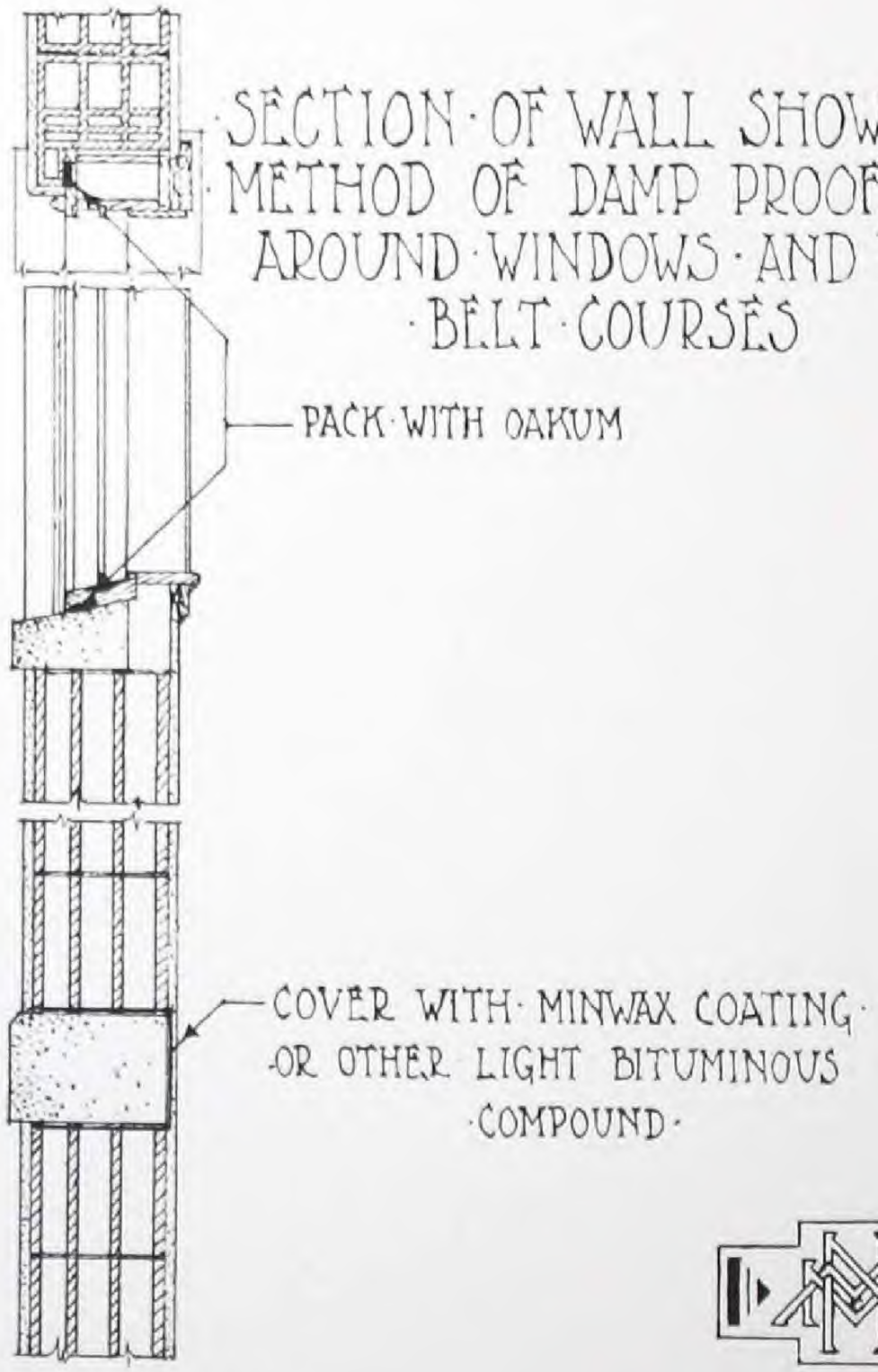
PREVENTION OF WET CELLARS

Cellar walls are usually made of concrete, stone, hollow tile or brick, Whichever material is chosen has to be used not only for the support of the structure above but also to act as a retaining wall to hold back the pressure of the earth so that weight as well as strength is required. In discussing the cellar problem, I shall assume a concrete wall to be

TEXTILE HOLLOW TILE BUNGALOW CONSTRUCTION WITHOUT CELLARS



SECTION OF WALL SHOWING METHOD OF DAMP PROOFING AROUND WINDOWS AND FOR BELT COURSES



Detail Drawings of Foundation Walls and Window Opening

used since that can be waterproofed both by the integral and coating methods while the other forms lend themselves to the coating method only.

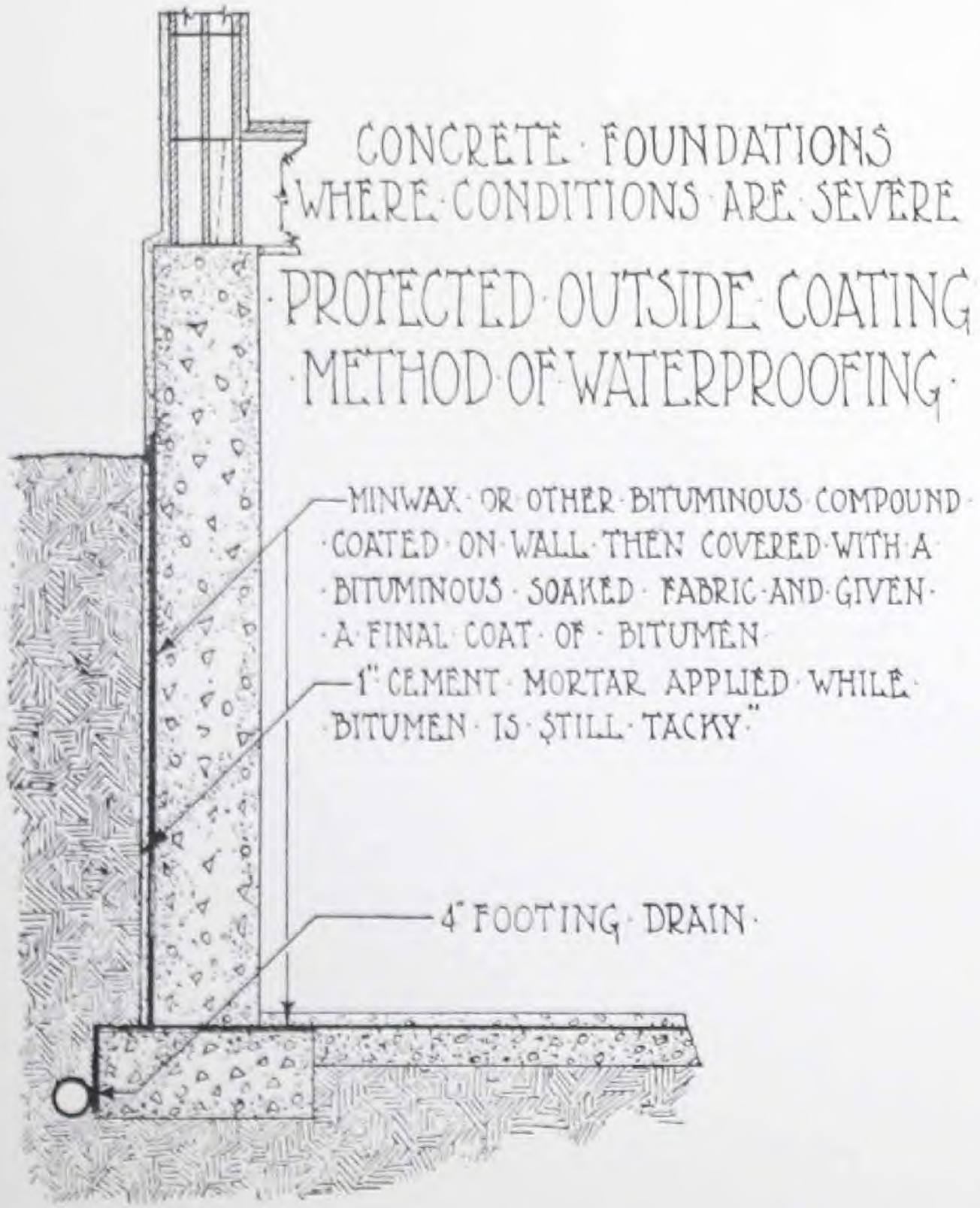
There is little danger of a damp cellar in a gravel or sandy soil, but in clay or loam or on rocky ground, the danger exists even where the cellar is situated on ridges and in places supposed to have good drainage.

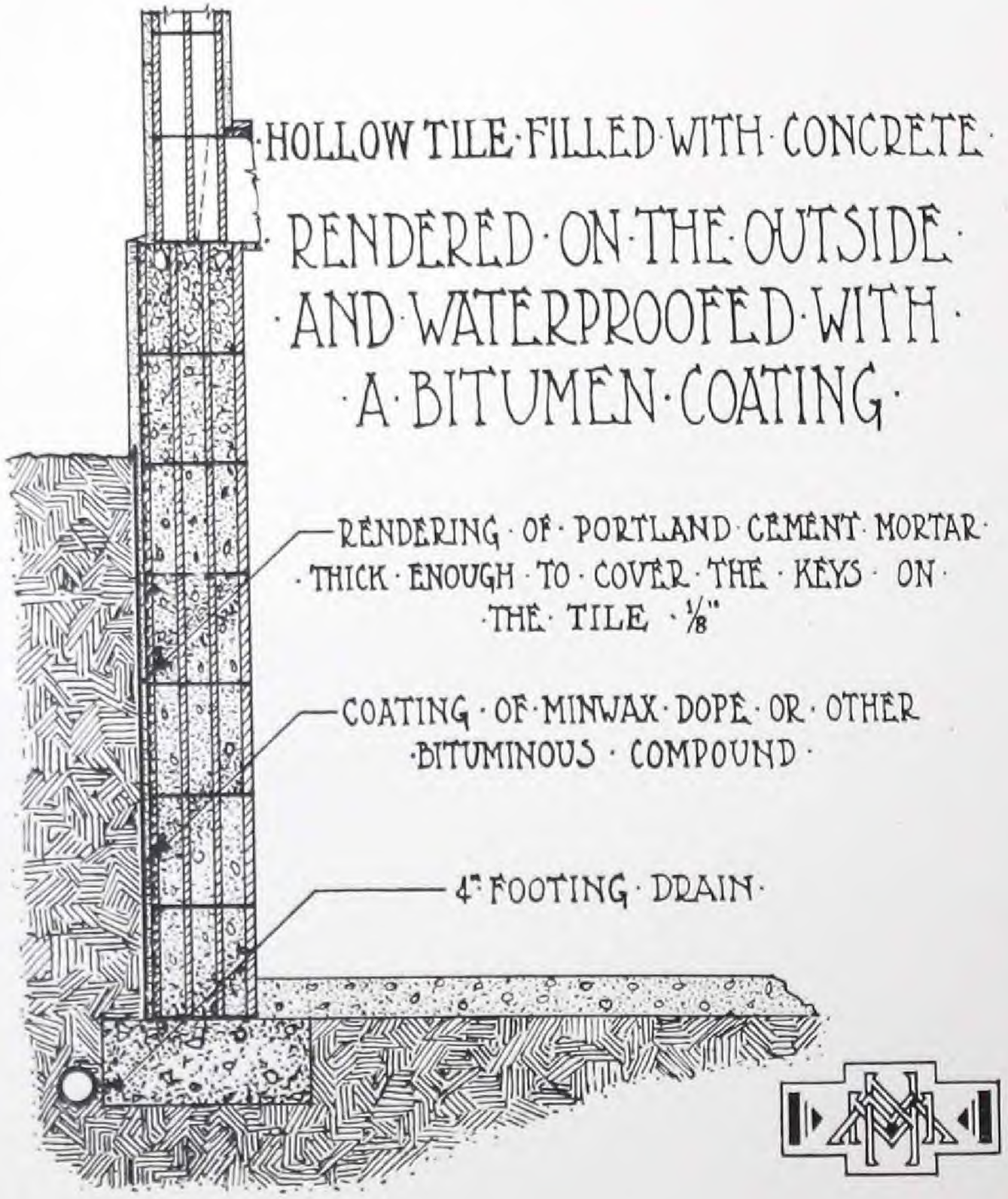
The surest way of preventing dampness in the cellar is to locate the house on high well drained ground. Unfortunately, the conditions generally met with make this impossible, and where they do, the next best way is to run a drain around the outside of the cellar wall. Such a drain is generally called a footing drain and it must be so located that the top of the drain is at least an 1″ below the top of the lowest point of the cellar floor. If this is done, the drain itself can be laid practically level, but it must have a point of discharge that will remove promptly all the accumulated water. Sometimes the surroundings are such that a point of discharge can be found in an adjoining ravine, or else the house can be kept sufficiently high, so that the discharge can be in the street gutter. Where neither of these ways are possible, it may be found that by digging a well in the center of the cellar deep enough to reach through the clay or loam soil down to a sand or gravel strata, and then filling the well with cinders or broken stone and connecting the footing drain with it, it will readily drain all accumulating water.

Having established an outlet for the footing drain, it is of next importance to see that the cellar walls are damp-proofed and that the damp-proofing extends down over the footings. The walls can be damp-proofed by making the surface reasonably smooth and then coating it with Minwax Dope or other heavy bituminous compound. The walls are prepared for this coating by removing or filling in with mortar all ledges, porous places and pinholes, and if this is well done one coat of the compound is enough. It must, however, be thoroughly applied. A hole no larger than the head of a pin will admit sufficient water to cause considerable trouble. It is the lack of full appreciation of this fact that results in many imperfect jobs.

After the walls are damp-proofed they should be back-filled with clean earth free from sharp stones that may bruise the waterproofing and the earth should be well tamped. In a clay or loam soil the tamping or pounding of the earth as it is filled in, is in many cases the only precaution against dampness that is necessary, since it is with difficulty that water penetrates a dense, hard soil. Many mine shafts are waterproofed with only wet clay properly puddled. In building operations, however, it is so difficult to insure this tamping being properly done, that it is not advisable to rely upon it alone.

It often happens that a new building is surrounded by loose filled-in earth that readily absorbs rainwater or that there are depressions where the earth has settled or that ungraded heaps of earth divert rainwater toward the cellar. By filling in around the house so that the ground slopes away from it, and by sodding or planting grass seed on the loose





Detail Drawings of Concrete and Hollow Tile Cellar Walls

filled-in earth, any difficulty from surface water accumulating in this way will be overcome.

In some classes of work, cellars are built with concrete walls against the earth embankment to save excavating a working space outside the walls. When they are constructed in this way a wooden form is built for the inside face of the wall only, the earth embankment acting as the outside form, and thus no opportunity is given to apply the waterproofing to the outside of the walls. It then becomes necessary to mix with the concrete a waterproofing powder such as is sold by the Integral Waterproofing Company, or, if the concrete has a portion of cinders in the mixture, so that it is excessively porous, it will be necessary to put a coating about $\frac{5}{8}''$ thick of waterproofing cement mortar around the inside of the walls to any needed height, generally two feet up from the cellar floor. The Waterproofing Company of New York makes a dry cement mortar for this purpose called" Cow Bay Waterproofing Cement." Very excellent results have also been obtained in waterproofing concrete by mixing with the cement fine iron dust such as is sold by "The Master Builders."

The bottom portions or footings for inside and outside walls in damp places should be coated with Minwax Dope to prevent the water rising in the walls through capillary attraction.

Where cellars are so placed that there can be no outlet for the footing drains and the sub-soil is too dense to carry off the water through a drainage well, the cellar floor and walls must be made tight so that water under pressure cannot be forced through them. The height of the ground water outside of the building, or, the height to which the ground is generally saturated, determines the pressure against which the walls and floors have to keep out the water. On account of this pressure, methods of waterproofing that would otherwise be satisfactory, will not serve under these conditions. If the pressure is strong, it will force off any waterproofing applied on the inside of the walls, and it will rupture and force its way through any waterproofing on the outside of the walls that has not been put on with the greatest care and protected with an outer masonry covering.

It would seem, therefore, that the best way of waterproofing under these conditions, would be to make the walls and floors of concrete, which will itself be impervious to water. This can be done by a very careful proportioning of the mixture and grading of the aggregate. In doing this it is necessary to see that when the concrete is poured it is well puddled, and the mixture should be wet enough so that no tamping is necessary. As the concrete is being poured, it should be well sliced with shovels. Where any danger exists of settlement cracks, it is desirable to mix iron fillings with the cement, such as is done in "The Master Builder's" method, or to coat the outside of the walls with some bituminous compound. The iron fillings, on account of their continued rusting, will fill up small cracks and make them impervious to water. If the bituminous coating is used great care must be taken to see that

the foundation upon which it is applied is smooth and perfect, and that some masonry covering is provided to prevent an abrasion or injury from the outside.

In private residences, cellar walls are frequently built of hollow tile construction and where added weight is necessary for stability against earth pressure the holes in the tile are filled with concrete. This does away with the necessity and consequent expense of forms to hold the concrete when it is being poured. These walls should be coated on the outside with cement mortar rendering. This coating may be applied in "The Master Builder's" method, or else, the tile wall can be carefully pointed and given a coating of ordinary Portland Cement Mortar rendering sufficient to cover the keys, and to this can be applied a bituminous preparation such as is prepared by the Minwax Company. When this is partly dry but is still tacky, a protecting coat of Portland Cement Mortar about ¼" thick should be spread over it.

The same principles govern in waterproofing cellar floors under conditions of water pressure. A thin concrete floor should first be laid with a smooth surface upon which is spread a bituminous soaked fabric bedded in and coated with bitumen. This should be covered with concrete sufficiently heavy to keep back the water, the thickness depending upon the height of the ground water outside.

Where the pressures are light, a finished surface laid on the regular cellar floor in accordance with "The Master Builder's" method will probably be sufficient without the bituminous coating, but in any case the waterproofing should go through the walls and connect with the waterproofing on the outside.

In using any integral method of waterproofing concrete or mortar, that is, a method where the waterproofing substance is mixed in with the mortar, it is important that no settlement cracks develop and that there are no cracks resulting from the shrinkage of the concrete in drying. Such shrinkage will occur between the juncture of two days' work or at haphazard intervals in the surface of the wall. It is on account of the difficulty of preventing this that the users of iron fillings are enthusiastic about their methods, since the continued rusting of the iron supplies a filling substance for small cracks as they open. Others claim that bituminous waterproofing products which are miscible with water, if mixed through the mortar, will guard against these difficulties. My own feeling is that when the waterproofing problem becomes a serious one, it is best to rely on the reputation of the contractors performing the work rather than on the specific method which they adopt. Their reputation, however, should be verified by careful inquiry concerning the results of the work which they have done.

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ILLUSTRATIONS

From of James McMillin Printing Co.
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